Practitioner's Docket No. 2550/185 *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Wachtmann
Application No.: 10/670,673 Group No.: 2814
Filed: September 25, 2003 Examiner: Pizarro Crespo, Marcos D
For: METHOD OF FORMING A SURFACE MICROMACHINED MEMS DEVICE

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF REPLY BRIEF

1. Transmitted herewith is the REPLY BRIEF in this application with respect to the Examiner's Answer mailed on May 29, 2007.

STATUS OF APPLICANT

2. This application is on behalf of a large entity.

EXTENSION OF TERM

3. Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Charge any fees required by this paper to deposit account number 19-4972.

Date: July 19, 2007

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Applicant:	Wachtmann	Atty. Docket:	2550/185
Serial No.:	10/670,673	Art Unit:	2814
Filing Date:	September 25, 2003	Examiner:	Pizarro Crespo, Marcos D
Invention:	METHOD OF FORMING A SURFACE MICROMACHINED MEMS DEVICE		

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REPLY BRIEF

Applicant submits this reply brief for the subject application, in response to the examiner's answer ("EA") mailed on May 29, 2007.

In response to item (9) Grounds of Rejection and item (10) Examiner's Argument of Examiner's Answer ("EA"), Applicant submits the following remarks. Applicant's remarks are organized according to each of the two grounds of rejection.

1. **Claims 1, 3-5, 7, 8, and 15-18 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Montague (US 5798283) in view of Kim (US 6500763) and Lee (US 6160314).**

A. The rejections over Montague in view of Kim and in view of Lee must fail because the device formed by Montague's process would not function properly as a MEMS device, if an oxide layer was substituted for Montague's nitride layer. Thus, a prima facie case of obviousness has not been made.

To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. See, *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974) ("All words in a claim must be considered in judging the patentability of that claim against the prior art.") See

also MPEP 2143.03. Claim 1 of the subject application is directed to a method of forming a surface micromachined MEMS device having both circuitry and structure. Among other limitations, Claim 1 requires "depositing a conductive path directly on an oxide" that was applied to a semiconductor substrate. This conductive path connects between the circuitry and structure.

In contrast, Montague '283 does not teach such a process. Instead, the Montague reference teaches depositing polysilicon on a silicon nitride insulating layer. In particular, as shown in fig. 1 and col. 6, lines 8-13 of Montague, Montague's MEMS device has a doped polysilicon layer 24 (a conductive path) on a silicon nitride layer 22. The EA notes that "Kim (see, e.g., col.4/11.15-20) and Lee (see, e.g., col.2/11.55-60), on the other hand, teach an oxide layer to be an equivalent material to Montague's nitride layer for its use as an etch/polish stop layer" (EA, page 5, first full para.) The EA then concludes that "Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use either an oxide or a nitride in Montague's method because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee…" (EA, page 5, third paragraph.)

This conclusion is wrong, however, because materials in semiconductor devices are not used in isolation from each other. Whether or not a material layer will work as an etch stop (or perform any other function) depends on a number of factors - geometries of the application, the material being etched, thicknesses, stress, etch chemistry, etch method, cost, etc. Kim '763 and Lee '264 do not teach a skilled engineer anything about whether or not nitride and aluminum oxide are 'equivalent' for use as an etch stop or for any other purpose in another device

application. While a material may be used in a first device for one property (e.g., the material serves as an etch stop or a polishing stop in Kim's device or Lee's device), substitution of the material in the first device for a material in a second device requires that all properties of the material as used in that second device be considered. Here, for example, substitution of Kim's or Lee's oxide layer for Montague's nitride layer will cause Montague's device not to function properly as a MEMS device. A non-functioning resultant device from Montague's process, as amended by Kim or Lee, is clear proof that the embodiment of Claim 1 of the subject application is not made obvious by the combination of Montague, Kim and Lee. Details follow immediately below.

Montague '283 illustrates the steps in Montague's process of forming a MEMS device in figures 2 through 13. Fig. 11 of Montague shows one such step

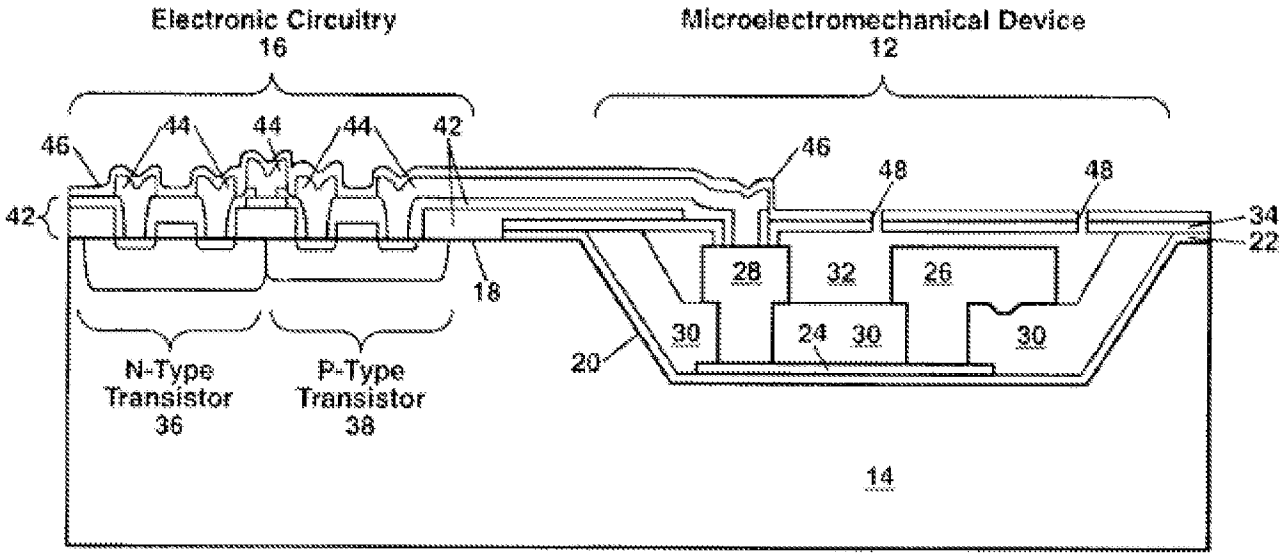


Fig. 11

Montague '283 teaches that:

"In FIG. 11, after fabrication of the electronic circuitry is substantially completed,…. the MEMS devices **12** are exposed to an etchant to remove the sacrificial material and release the MEMS devices into their final suspended states for movement or operation." (Montague '283, col. 8, lines 41-49.)

One or more etch channels **48** are formed by etching downwards to the sacrificial layers **30, 32**. (Montague '283, col. 8, lines 59-61).

Montague's fig. 12 shows the subsequent etch step in the process:

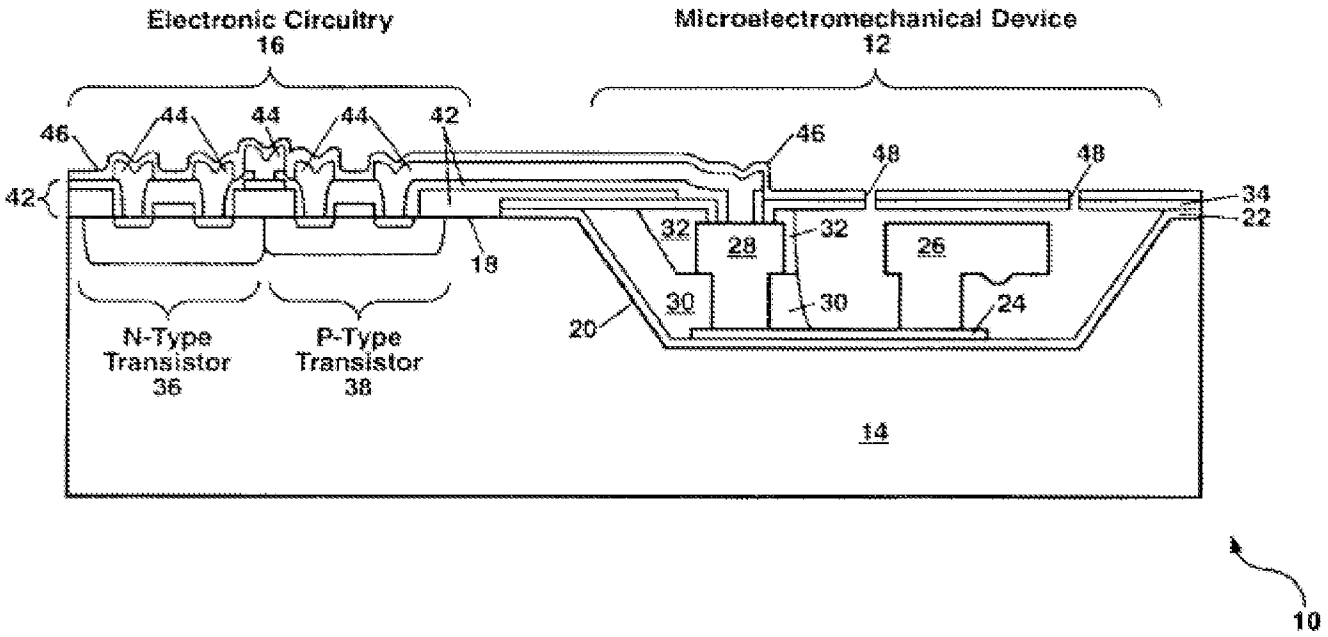


Fig. 12

"FIG. 12 shows the substrate with integrated MEMS devices and electronic circuitry after a wet etching step in which the sacrificial material (e.g. sacrificial layers 30 and 32) is removed at least in part by a chemical etchant (e.g. buffered HF). **The etchant composition is selected to dissolve the sacrificial material but not to affect other materials (e.g. polysilicon, nitride, metals, resist, polyimide)** that may be used for forming the MEM devices and protecting the electronic circuitry." (Montague '283, col. 8, lines 59-61, emphasis added).

In other word, Montague '283 explicitly teaches that the etchant must not affect other parts of the MEMS device, including the insulating nitride layer **22**. If Montague's silicon nitride insulating layer (**22** in figs. 11 and 12) device is replaced by an oxide layer as taught by Kim or Lee, the etchant material used to dissolve sacrificial layer **30, 32** will also dissolve the oxide in insulating layer **22**. Dissolution of insulating layer 22 yields a non-functional MEMS device because this layer **22** will debond from the substrate **14** allowing the conductive layer **24** to short with this substrate. Integrity of the MEMS structures **26, 28** will also be compromised. Thus, Claim 1 is clearly non-obvious over Montague '283 in view of Kim or Lee because the process taught by this combination of references will not form a properly functioning MEMS device.

Because Claim 1 is allowable over the cited art, claims 3-5, 7 and 8, which depend from Claim 1 and add further limitations are also allowable for at least the same reasons as for Claim 1.

Claim 15, like Claim 1, requires, in part:

"…forming a conductive path directly on the oxide… the oxide electrically isolating the conductive path from the substrate."

Thus, Claim 15 and Claims 16-18, which depend from Claim 15 and add further limitations, should be allowed for the same reasons as for Claim 1.

B. These rejections for obviousness must fail because no convincing motivation or suggestion to combine either of the secondary references (Kim/Lee) with the primary reference (Montague) to achieve the claimed embodiments of the invention has been shown. Thus, a prima facie case of obviousness has not been made.

A prima facie case of obviousness requires, *inter alia*, some teaching, suggestion, or motivation to combine the cited references. See, e.g., *In re Kahn*, 441 F.3d 977, 986 (Fed. Cir. 2006); MPEP 2143.01. As discussed in detail in Applicants' Appeal Brief ("AB"), no showing has been made that one of ordinary skill in the art would be motivated by Kim's use of an oxide as an etch stop or Lee's use of an oxide as an etch stop to replace Montague's nitride insulating layer **22** with an oxide layer. (See AB, pages 9-15.) The EA repeatedly asserts that Kim and Lee teach an oxide layer to be equivalent to Montague's nitride layer for its use as an etch/polishing stop, as if such equivalence as an etch/polishing stop is dispositive for obviousness of the combination. (See, e.g., EA, page 4, second para.; page 6, second para. ; page 9, first para; page 10; page 11, second para., etc.). This conclusion is clearly wrong. If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. See, *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984); MPEP 2143.01 (V). Here, as shown above, replacing the nitride layer 22 with an oxide layer in Montague's process yields a non-functioning MEMS device because Montague's etchant would eat away this oxide layer. Because Montague's process would then

be unsuitable for its intended purpose, there is no suggestion or motivation to make the proposed modification, regardless of how useful an oxide layer might be in Kim's or Lee's device as an etch or polishing stop.

Further, the EA implies that if Montague's process steps are performed, the results of the process will be the same, irrespective of the material used. For example, the EA states:

"With regards to the ability of layer **22** to form a seal with Montague's cap layer, **forming a seal would only require following Montague's method steps.** Applying Lee's teachings of equivalency so as to use aluminum oxide for Montague's layer **22** does not eliminate the step of forming the layer nor does it eliminate or change the sequence of any of the subsequent method steps. That is, Lee is not suggesting eliminating layer **22** or eliminating, disrupting, or changing the sequence of any of Montague's method steps. Lee is only suggesting an alternative material to be used when forming Montague's layer **22. Therefore, once it is formed, Montague's cap layer 34 will still form a seal with layer 22 as there is nothing in Lee's teachings that would affect the way in which Montague's method steps are performed.** It should be kept in mind that this seal is only temporary and is meant to protect the MEM device **12** while forming CMOS circuitry **16** (see, e.g., Montague:figs.8-10, col7/11.22-27 and col.7/1165-co1.8/II.2). (EA, page 11, last para.to page 12, first para.)

Applicant traverses the assertions shown in bold because there has been no showing that an oxide-to-oxide cap will be successfully formed using Montague's method. While the seal may be temporary, as the EA asserts, failure to form this seal may lead to damage to the MEMS device structures which will compromise the device produced by Montague's method.

For the sake of a clear record, Applicant points out that Applicants' description of Montague's insulating layer 22 in the AB as a "singular layer" was to contrast Montague's layer 22 with Lee's use of an oxide in Lee's application – a very different application from Montague's. Applicant agrees that Montague's nitride layer is, in fact, formed on a thin silicon dioxide layer which directly

contacts the substrate, as Applicant clearly states in the AB, page 12, first paragraph. Further, Applicant never stated that Claim 1 required a singular insulating layer. See, e.g., AB, page 9, second para. However, Applicant does traverse the erroneous conclusion in the EA that because "aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as an etch/polish stop layer.... It would have been obvious ... to replace the nitride in Montague's layer with an oxide." (EA, page 9, first full para.). Substitution of a second material for an existing material in a semiconductor device application requires the determination that the substituted material has all relevant properties of the existing material. The best etch/polishing stop material is not an obvious substitution if, as here, the material is not compatible with adjacent materials in the fabrication process.

For each of the reasons cited above, Claims 1, 3-5, 7, 8, and 15-18 are allowable over the art of record in this application.

2. **Claim 19 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Montague/Kim/Lee in view of Fladre (US 2004/0152272).**

The rejection for obviousness of Claim 19 relies on Montague/Kim/Lee for teaching the limitations of Claim 15, from which Claim 19 depends. (See EA, page 6, last paragraph.) As described above, a prima facie case of obviousness has not been made to combine either of the secondary references, Kim and Lee, with the primary reference, Montague, to achieve the embodiment of Claim 15. Fladre, likewise, does not provide the missing elements in a prima facie case of obviousness, lacking in Montague/Kim/Lee, to combine Montague and Kim or

Lee to achieve the embodiment of Claim 15. Thus, Claim 19 is deemed non-obvious over Montague/Kim/Lee in view of Fladre and should be allowed.

For the reasons set forth in Applicant's Appeal Brief and those expressed above, Applicant submits that all pending claims in the application are allowable over the art of record and early notice to that effect is respectfully solicited.

Respectfully submitted,

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